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(54) **IN-WHEEL MOTOR AND IN-WHEEL DRIVING DEVICE**

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H02K 41/03	(2006.01)
H02K 7/116	(2006.01)
B60K 7/00	(2006.01)
B60K 17/04	(2006.01)

(52) **U.S. Cl.**

CPC ***H02K 7/14*** (2013.01); ***H02K 41/031*** (2013.01); *B60K 7/0007* (2013.01); *B60K 17/046* (2013.01); *B60K 2007/0038* (2013.01); *B60K 2007/0092* (2013.01); *H02K 7/116* (2013.01); *H02K 2201/15* (2013.01); *Y02T 10/641* (2013.01)

(58) **Field of Classification Search**

CPC H02K 1/148; H02K 7/006; H02K 7/116; H02K 7/148; H02K 16/04; H02K 21/18; H02K 2201/15; H02K 7/102; H02K 41/031; B60K 7/00; B60K 7/0007

USPC .... 310/67 R

See application file for complete search history.

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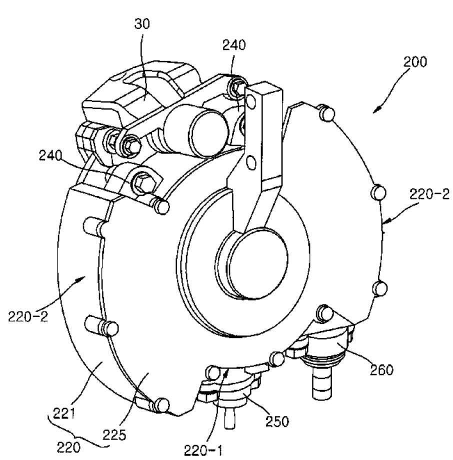
(57) **ABSTRACT**

An in-wheel motor includes: a motor rotor installed inside a wheel of a vehicle; and a plurality of motor stators installed on the circumference of the motor rotor so as to be separated from each other, and forming magnetic fields to rotate the motor rotor.

22 Claims, 11 Drawing Sheets



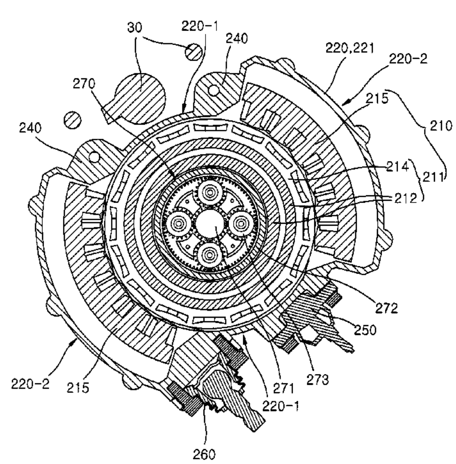


Fig. 1

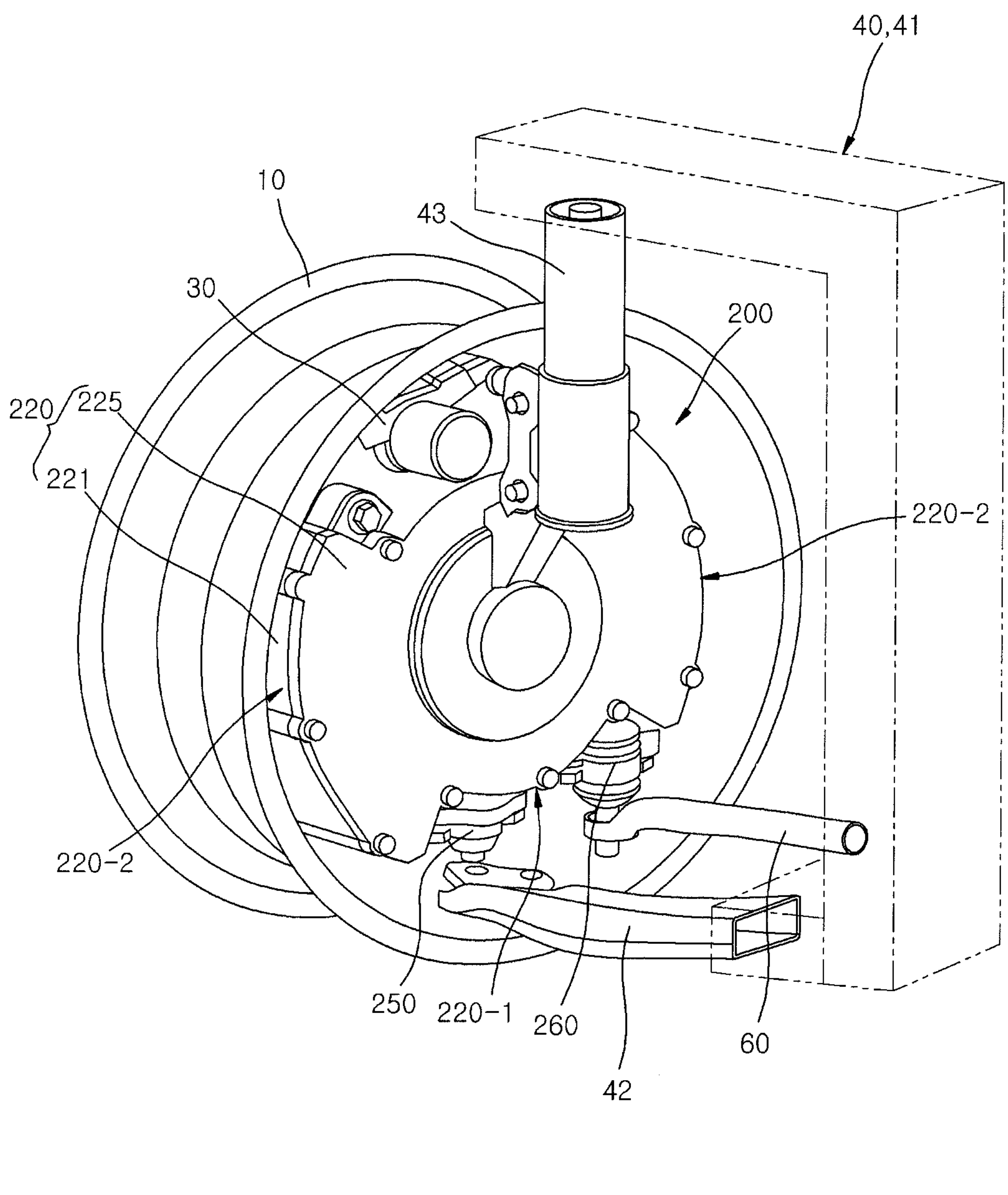


Fig. 2

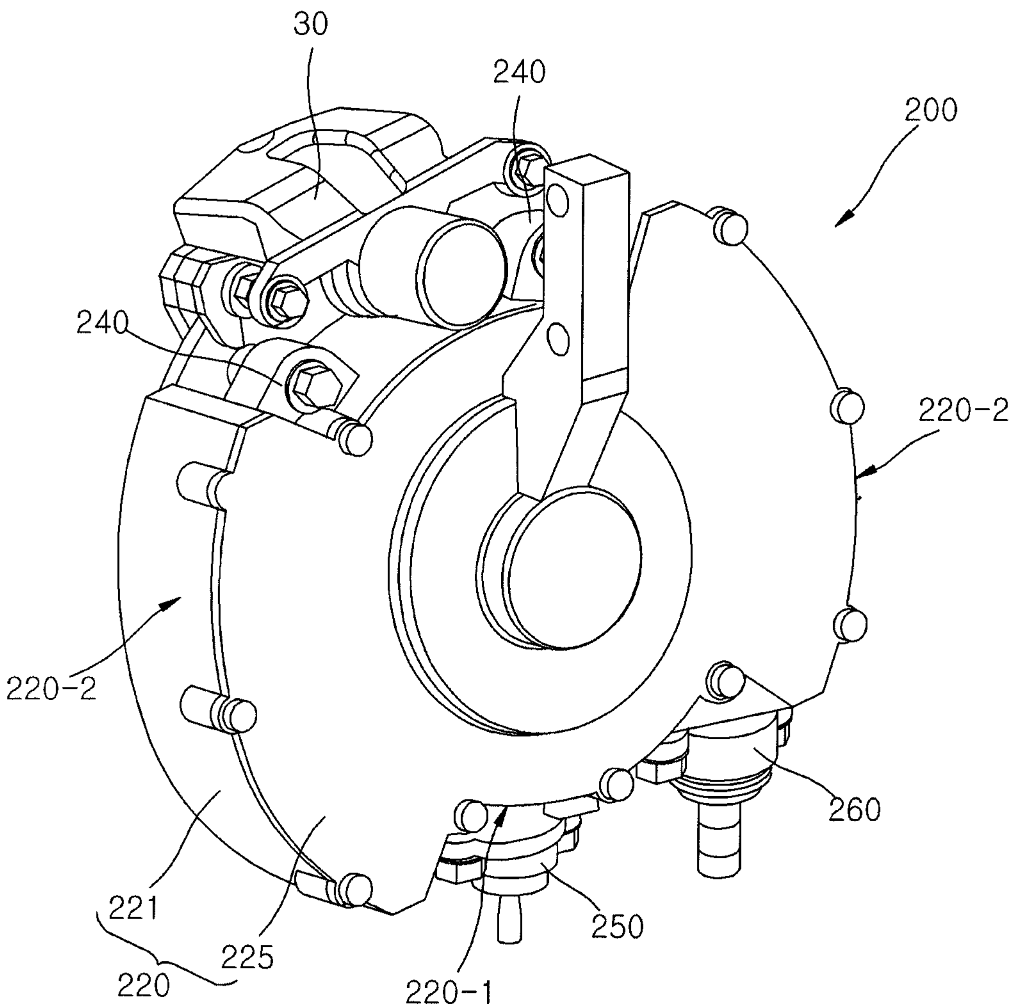


Fig. 3

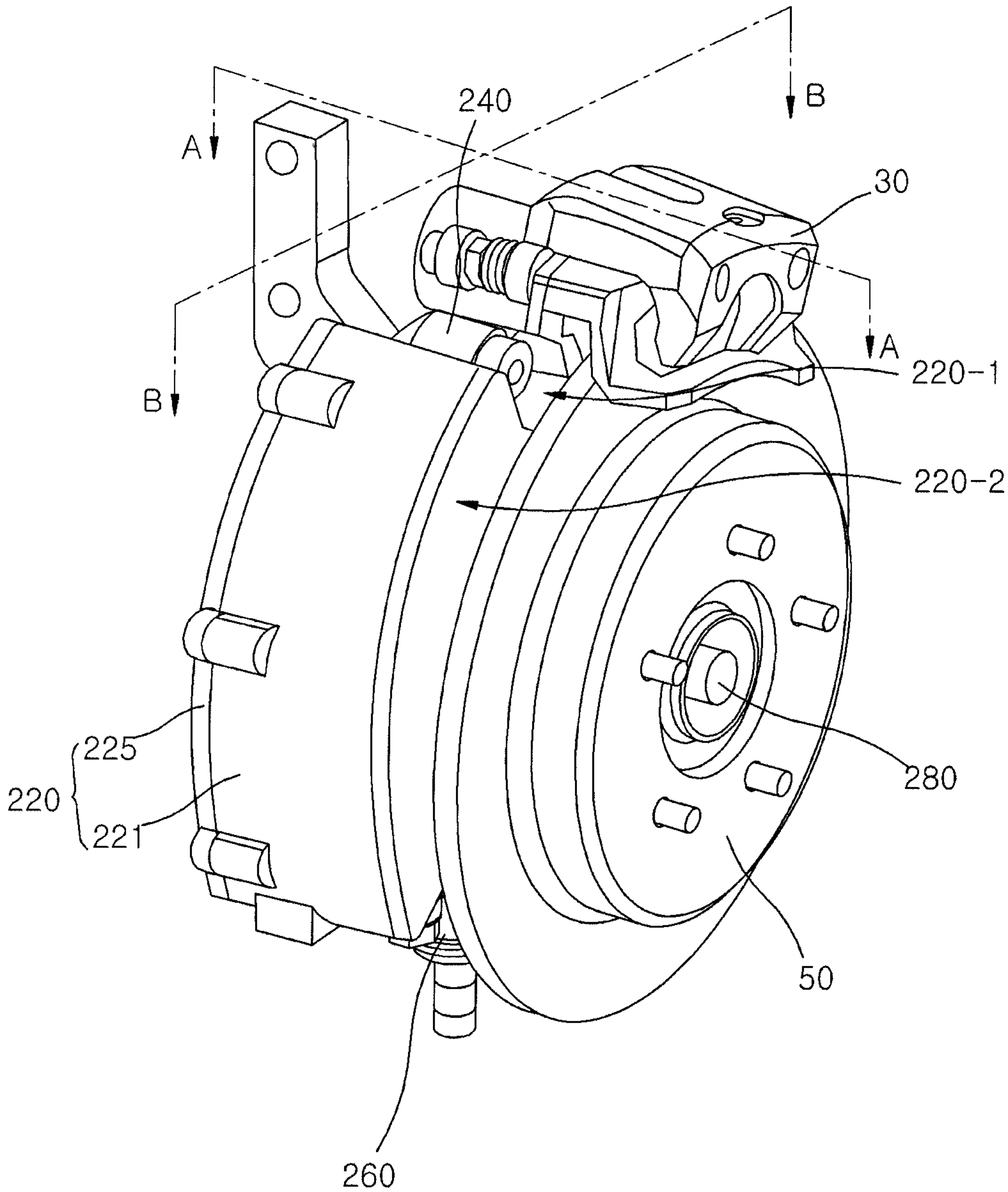


Fig. 4

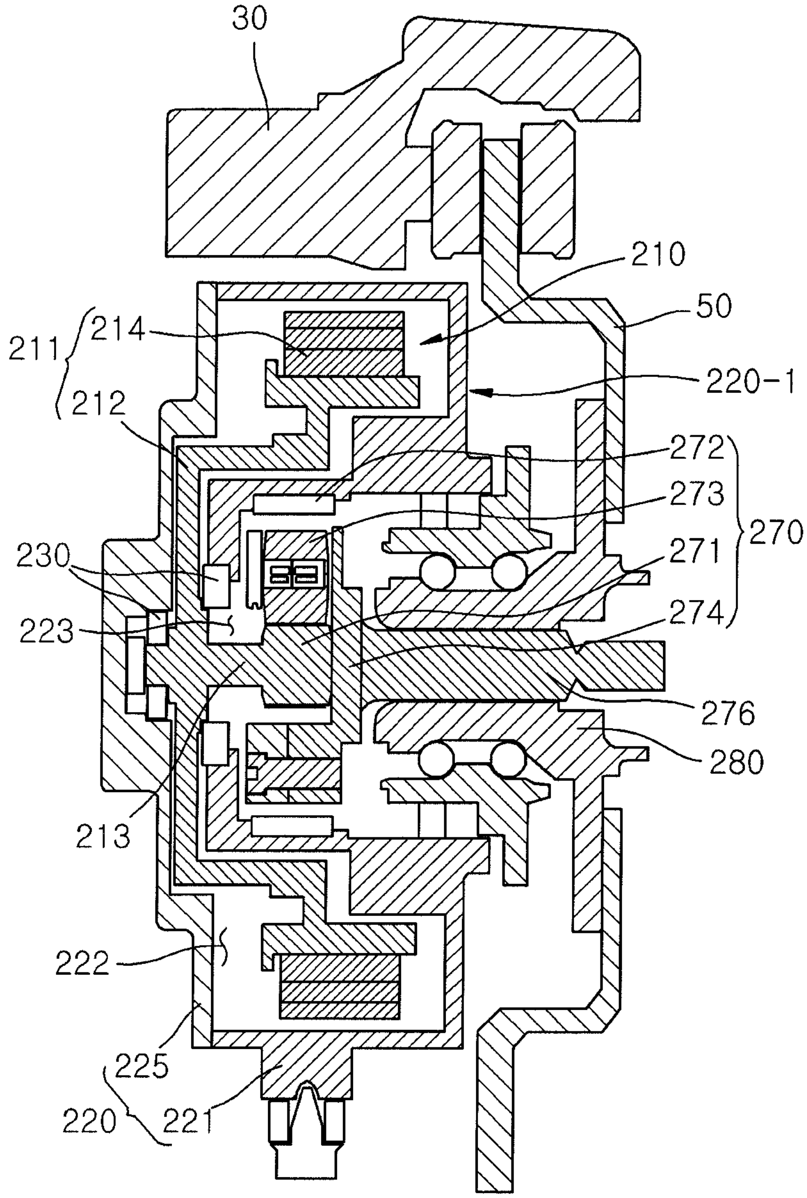
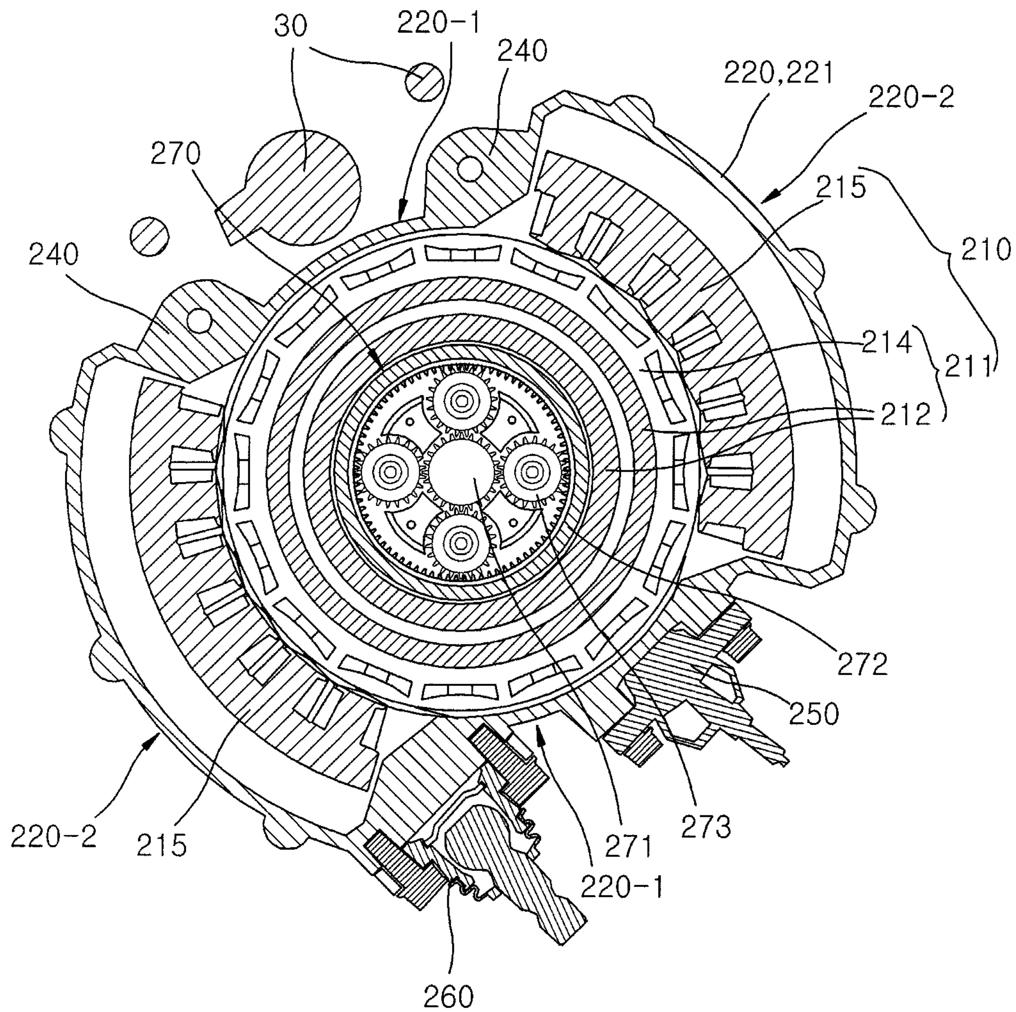

30
210
50
211
214
212
220-1
272
273
270
230
271
223
274
276
280
213
222
225
220
221

Fig. 5


30
220-1
240
220,221
220-2
270
215
210
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212
272
250
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215
271
273
220-1
260

Fig. 6

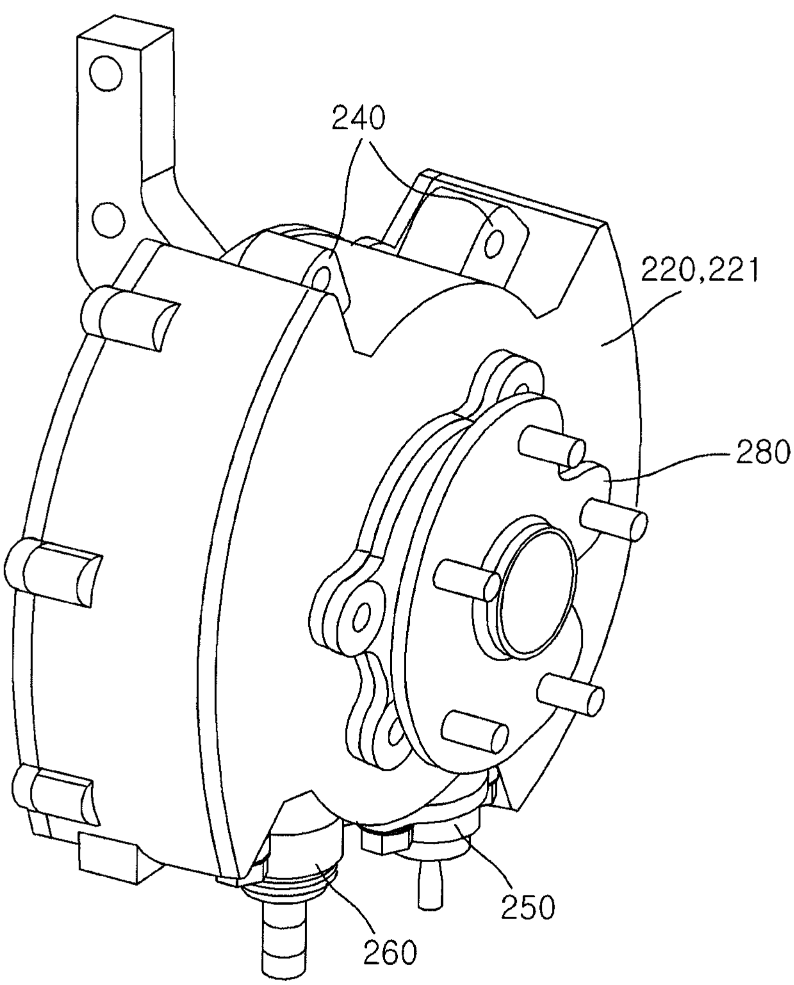
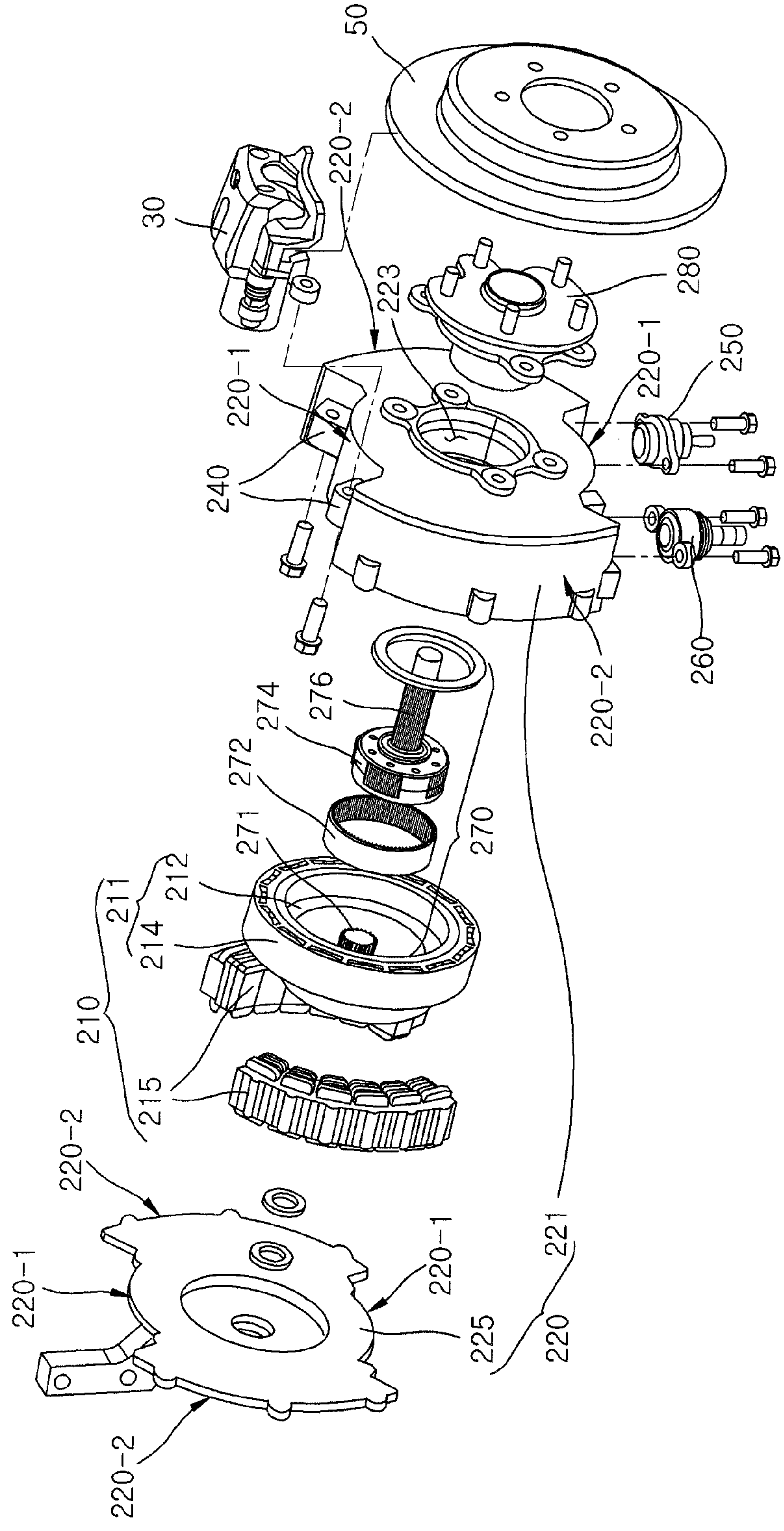


Fig. 7


50
220-2
30
280
223
220-1
250
240
260
276
274
272
271
270
212
211
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215
221
225
220

Fig. 8

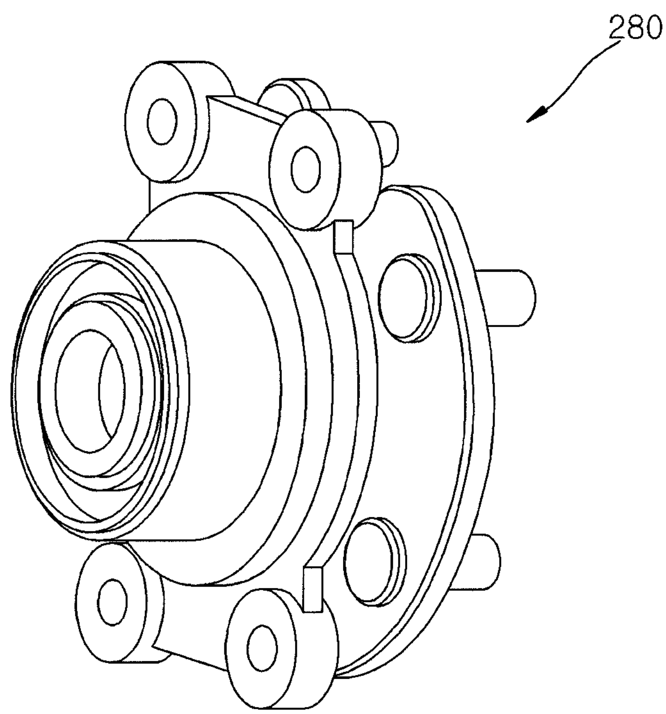


Fig. 9

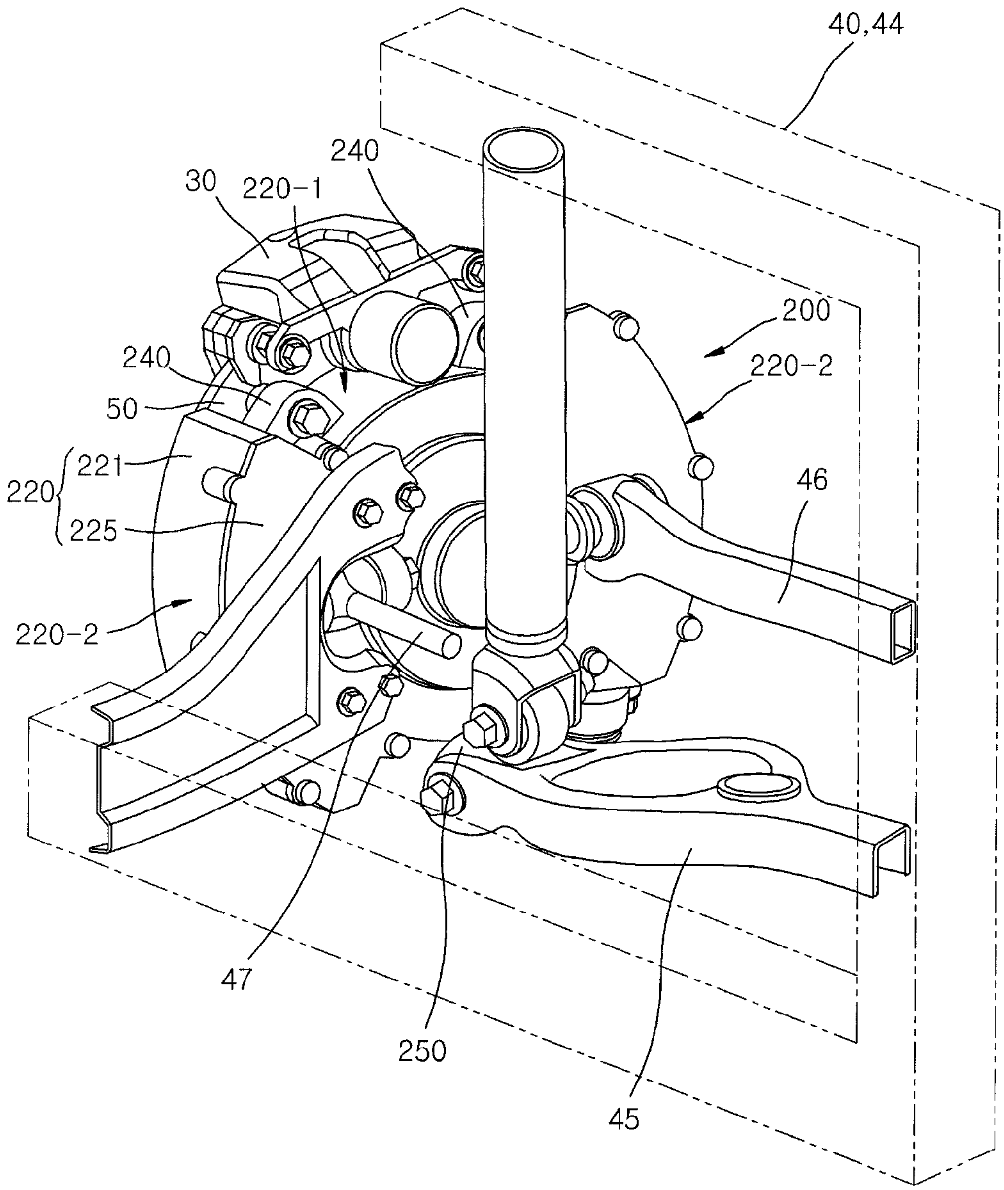


Fig. 10

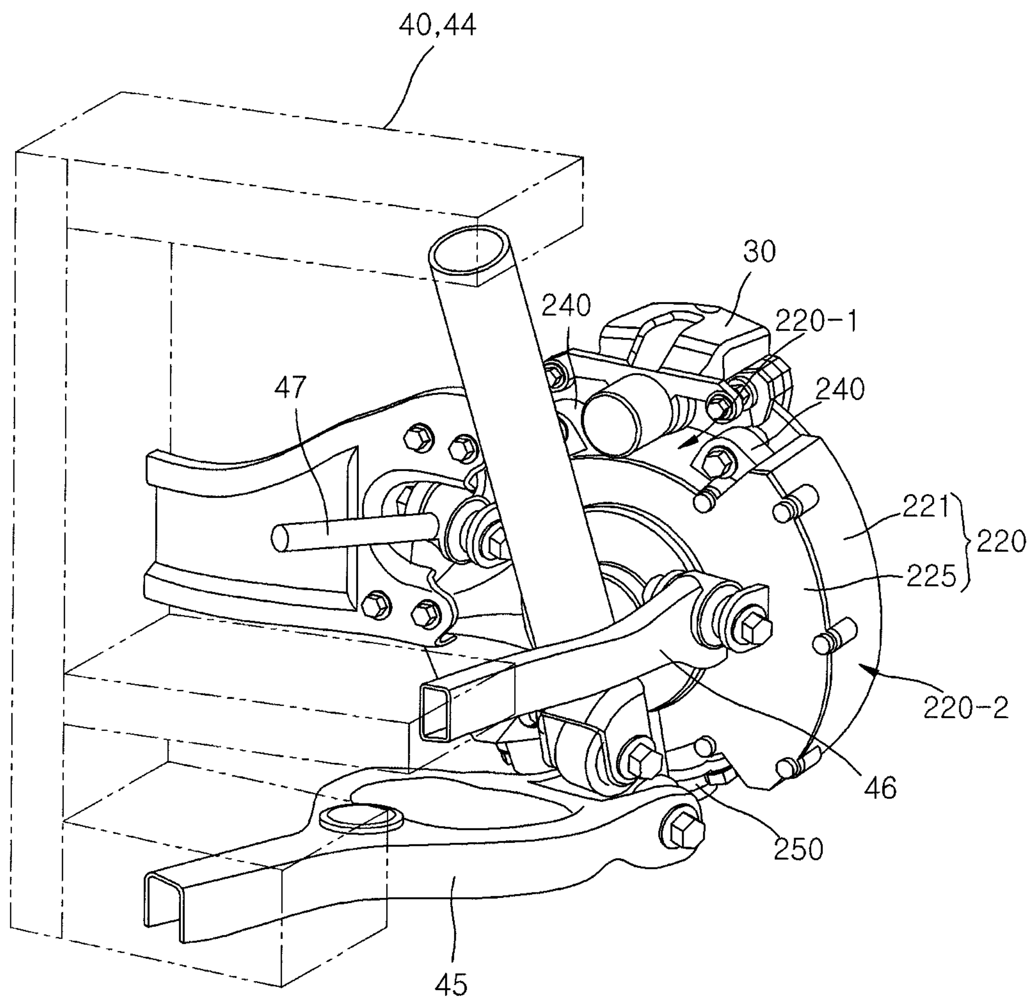
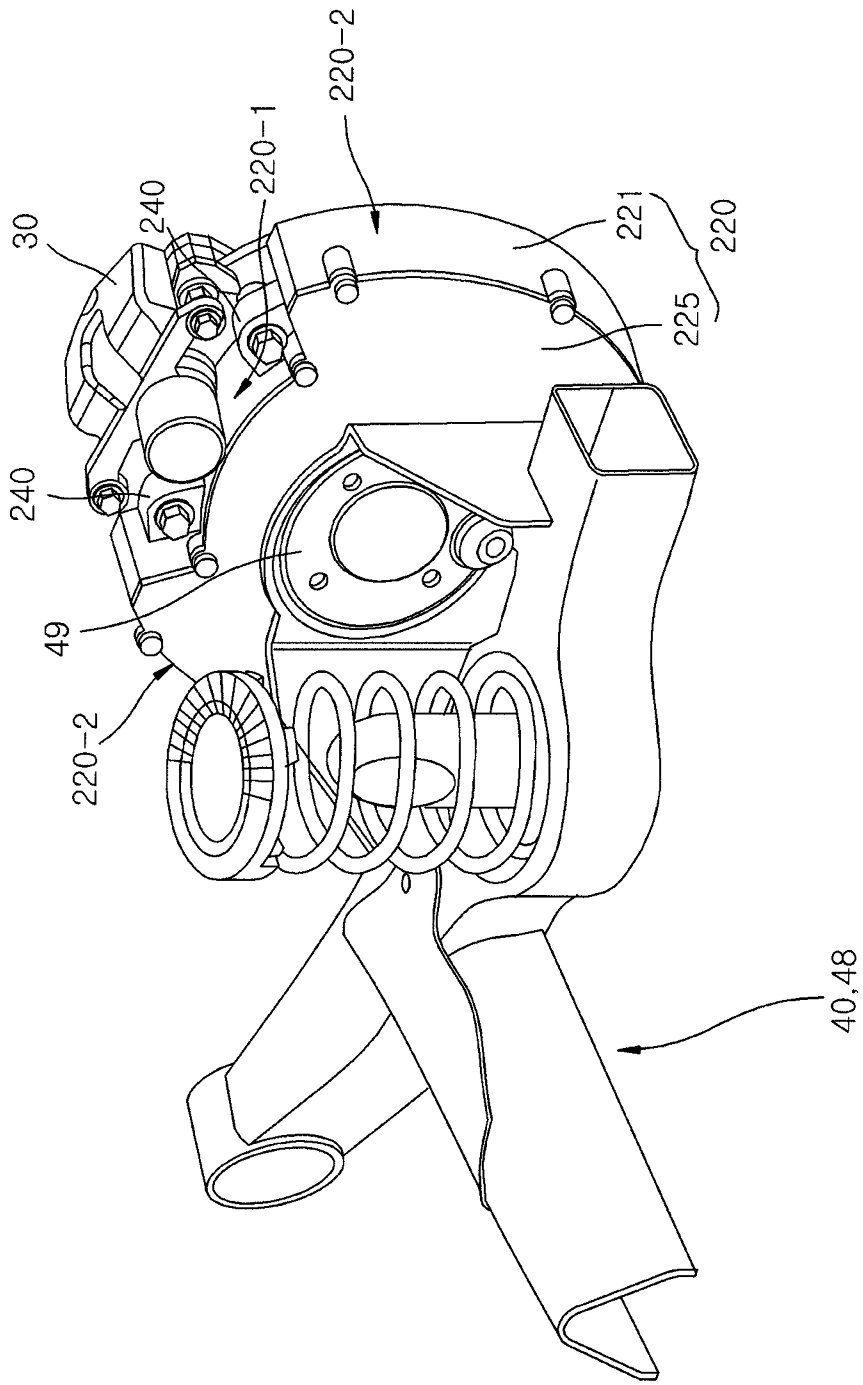


Fig. 11



IN-WHEEL MOTOR AND IN-WHEEL DRIVING DEVICE

CROSS-REFERENCES TO RELATED APPLICATIONS

The present application claims priority to Korean application number 10-2012-0076181, filed on Jul. 12, 2012, which is incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

The present invention relates to an in-wheel motor and an in-wheel driving device, and more particularly, to an in-wheel motor and an in-wheel driving device which may be efficiently mounted in a limited internal space of a wheel.

As fossil fuel is gradually exhausted, an electric vehicle to drive a motor using electric energy stored in a battery has been developed instead of a vehicle using fossil fuel such as gasoline or diesel.

The electric vehicle is divided into a pure electric vehicle to drive a motor using only electric energy stored in a rechargeable battery, a solar cell vehicle to drive a motor using a photoelectric cell, a fuel cell vehicle to drive a motor using a fuel cell which uses a hydrogen fuel, and a hybrid vehicle to drive an engine using fossil fuel and drive a motor using electricity.

In general, an in-wheel driving device is a technology used in a vehicle such an electric vehicle, which uses electricity as a power source. The in-wheel driving device directly transmits power to wheels through a motor disposed in two left and right driving wheels or four left/right and front/rear driving wheels, unlike a method for rotationally driving a wheel by transmitting power through an engine, a transmission, and a driving shaft in a gasoline or diesel vehicle.

The related art of the present invention is disclosed in Korean Patent Laid-open Publication No. 2011-0040459 published on Apr. 20, 2011 and titled “Wheel driving device for in-wheel system”.

A conventional in-wheel motor has a cylindrical shape. Accordingly, a circular space is formed between a wheel and the motor.

The in-wheel motor must have such a size as to stably position a brake system and a suspension system in a space formed between the wheel and the in-wheel motor. Therefore, the in-wheel motor has a limitation in increasing an output.

In order to increase the output of the in-wheel motor, the size of the in-wheel motor must be increased. At this time, the size (depth) of the wheel must also be increased. When the size of the wheel is increased, an arm member of the suspension system may easily interfere with the wheel and may not be smoothly rotated. In particular, when the in-wheel motor is applied to a front wheel, the interference between the wheel and the suspension system additionally occurs.

SUMMARY OF THE INVENTION

Embodiments of the present invention are directed to an in-wheel motor and an in-wheel driving device which may be efficiently mounted in a limited internal space of a wheel.

In one embodiment, an in-wheel motor includes: a motor rotor installed inside a wheel of a vehicle; and a plurality of motor stators installed on the circumference of the motor rotor so as to be separated from each other, and forming magnetic fields to rotate the motor rotor.

The motor stators may be arranged at even intervals on the circumference of the motor rotor.

The motor stators may be arranged on the circumference of the motor rotor so as to be symmetrical with each other.

The motor rotor may include a permanent magnet, and the motor stator may include an electromagnet.

The motor rotor may include a magnetic material, and the motor stator may include an electromagnet.

In another embodiment, an in-wheel driving device includes: a motor rotor installed inside a wheel of a vehicle; a plurality of motor stators installed on the circumference of the motor rotor so as to be separated from each other, and forming magnetic fields to rotate the motor rotor; a motor cover covering the motor rotor and the motor stators; and a caliper connection connected to the motor cover in one of spaces formed between the respective stators and having a caliper fixed and installed thereon.

The motor rotor may include: a rotor shaft rotatably supported by a bearing; and a magnetic rotating body including a permanent magnet or magnetic material, coupled to the circumference of the rotor shaft, and rotated by the magnetic fields formed by the motor stators.

The motor stators may be arranged at even intervals on the circumference of the motor rotor.

The motor stators may be arranged on the circumference of the motor rotor so as to be symmetrical with each other.

The motor cover may include: a rotor cover portion covering an outer surface of the motor rotor; and a stator cover portion covering an outer surface of the motor stator.

An inner surface of the rotor cover portion may have a predetermined gap from the outer surface of the motor rotor.

An inner surface of the stator cover portion may have a predetermined gap from the outer surface of the motor stator.

The caliper connection may be formed in the rotor cover portion.

The motor cover may include: a motor housing portion which has a concave shape to house the motor rotor and the motor stators therein and through which a shaft portion of the rotor shaft passes; and a lid portion covering an opening of the motor housing portion and coupled to the motor housing portion.

The in-wheel driving device may further include a suspension system connection fixed and installed on the motor cover in another of the spaces formed between the respective motor stators, and connected to an end of the suspension system.

The caliper connection may be positioned in one of the plurality of spaces formed between the motor stators, and the suspension system connection may be positioned in another of the plurality of spaces formed between the motor stators.

The suspension system connection may be connected to a lower arm of a MacPherson strut suspension, and a strut of the MacPherson strut suspension may be fixed and installed on the motor cover.

The suspension system connection may be connected to a lower arm of a multi-link suspension, and an upper arm and an assist arm of the multi-link suspension may be fixed and installed on the motor cover.

A spindle mounting bracket of a coupled torsion beam axle (CTBA) suspension may be fixed and installed on the motor cover.

The in-wheel driving device may further include a steering system connection fixed and installed on the motor cover in another of the spaces formed between the motor stators and connected to an end of a steering system.

The caliper connection may be positioned in one of the plurality of spaces formed between the motor stators, and the steering system connection may be positioned in another of the plurality of spaces formed between the motor stators.

The in-wheel driving device may further include a decelerator reducing and outputting a rotational displacement of the motor rotor; and a hub bearing rotatably supporting an output shaft of the decelerator and fixed and installed on the motor cover.

The decelerator may include: a sun gear connected to the motor rotor, rotated on the same axis as the motor rotor, and having gear teeth formed on the outer circumference thereof; a ring gear having gear teeth formed on the inner circumference thereof and installed outside the sun gear so as to be separated from the sun gear; a plurality of planet gears installed between the sun gear and the ring gear and revolving and rotating in connection with rotation of the sun gear; and a carrier connected to the rotation centers of the respective planet gears, decelerated and rotated at a speed corresponding to the rotation of the planet gears, and having the output shaft formed in the rotation center thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view illustrating an installation state of an in-wheel driving device in accordance with an embodiment of the present invention.

FIG. **2** is a perspective view illustrating a state in which a caliper is installed in the in-wheel driving device in accordance with the embodiment of the present invention,

FIG. **3** is a perspective view illustrating the state in which the caliper is installed in the in-wheel driving device in accordance with the embodiment of the present invention, seen from another direction.

FIG. **4** is a cross-sectional view of the in-wheel driving device in accordance with the embodiment of the present invention, taken along line A-A of FIG. **3**.

FIG. **5** is a cross-sectional view of the in-wheel driving device in accordance with the embodiment of the present invention, taken along line B-B of FIG. **3**.

FIG. **6** is a perspective view of the in-wheel driving device in accordance with the embodiment of the present invention.

FIG. **7** is an exploded perspective view of the in-wheel driving device in accordance with the embodiment of the present invention.

FIG. **8** is a perspective view of a hub bearing of the in-wheel driving device in accordance with the embodiment of the present invention.

FIG. **9** is a perspective view illustrating an installation state of an in-wheel driving device in accordance with another embodiment of the present invention.

FIG. **10** is a perspective view illustrating the installation state of the in-wheel driving device in accordance with the embodiment of the present invention, seen from another direction.

FIG. **11** is a perspective view illustrating an installation state of an in-wheel driving device in accordance with yet another embodiment of the present invention.

DESCRIPTION OF SPECIFIC EMBODIMENTS

Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.

The drawings are not necessarily to scale and in some instances, proportions may have been exaggerated in order to clearly illustrate features of the embodiments.

Furthermore, terms to be described below have been defined by considering functions in embodiments of the present invention, and may be defined differently depending on a user or operator's intention or practice. Therefore, the definitions of such terms are based on the overall descriptions of the present specification.

FIG. **1** is a perspective view illustrating an installation state of an in-wheel driving device in accordance with an embodiment of the present invention. FIGS. **2** and **3** are perspective views illustrating a state in which a caliper is installed in the in-wheel driving device in accordance with the embodiment of the present invention, seen from various directions.

FIG. **4** is a cross-sectional view of the in-wheel driving device in accordance with the embodiment of the present invention, taken along line A-A of FIG. **3**. FIG. **5** is a cross-sectional view of the in-wheel driving device in accordance with the embodiment of the present invention, taken along line B-B of FIG. **3**.

FIG. **6** is a perspective view of the in-wheel driving device in accordance with the embodiment of the present invention. FIG. **7** is an exploded perspective view of the in-wheel driving device in accordance with the embodiment of the present invention. FIG. **8** is a perspective view of a hub bearing of the in-wheel driving device in accordance with the embodiment of the present invention.

FIGS. **9** and **10** are perspective views illustrating an installation state of an in-wheel driving device in accordance with another embodiment of the present invention, seen from various directions. FIG. **11** is a perspective view illustrating an installation state of an in-wheel driving device in accordance with yet another embodiment of the present invention.

Referring to FIGS. **1** to **5**, the in-wheel driving device **200** in accordance with the embodiment of the present invention includes a motor rotor **211**, a plurality of motor stators **215**, a motor cover **220**, a caliper connection **240**, a suspension system connection **250**, a steering system connection **260**, a decelerator **270**, and a hub bearing **280**.

The motor rotor **211** is rotated in place by the influence of magnetic fields formed by the motor stators **215**.

Referring to FIGS. **4** and **5**, the motor stator **211** includes a rotor shaft **212** and a magnetic rotating body **214**. The rotor shaft **212** is rotatably supported by a bearing **230**. The magnetic rotating body **214** includes a magnetic body such as a permanent magnet or metal and is coupled to the circumference of the rotor shaft **212**. The magnetic rotating body **214** is rotated together with the rotor shaft **212** by the influence of the magnetic fields formed by the motor stator **215**.

The rotor shaft **212** has a shaft portion **213** formed in the rotation center thereof. The shaft portion **213** is connected to the decelerator **270** which reduces the rotation displacement of the shaft portion **213** so as to increase torque.

The plurality of motor stators **215** are installed on the circumference of the motor rotor **211** so as to be separated from each other, and form the magnetic fields to rotate the motor rotor **211**.

In a state where the in-wheel driving device **200** in accordance with the embodiment of the present invention is installed inside the wheel **10** as illustrated in FIG. **1**, the motor rotor **211** is positioned on the same axis as the rotation center of the wheel **10**, and the motor stators **215** are positioned between the motor rotor **211** and the wheel **10**.

Referring to FIG. **5**, a one side portion of the motor stator **215**, positioned adjacent to the motor rotor **211**, forms an arc-shaped curved surface corresponding to the circumference of the motor rotor **211**. Hereafter, the one side portion is referred to as an inner surface portion.

The in-wheel driving device **200** in accordance with the embodiment of the present invention has a structure in which two motor stators **215** each having an arc-shaped inner surface portion corresponding to a 90-degree displacement in the circumference of the motor rotor **211** are installed at even intervals so as to be symmetrical with each other.

When the motor stators **215** are arranged at even intervals on the circumference of the motor rotor **211**, the magnetic fields formed by the motor stators **215** are uniformly applied at even intervals across the entire circumference (360 degrees) of the motor rotor **211**.

Accordingly, since the magnetic fields applied to the motor rotor **211** are not concentrated on one side, the rotation of the motor rotor **211** may be stably performed.

When a plurality of motor rotors **215** having the same shape are arranged at even intervals, the plurality of motor rotors **215** are symmetrical with respect to the rotation center of the motor rotor **211**.

When a motor stators **215** having different shapes are symmetrically arranged on the circumference of the motor rotor **211**; magnetic fields applied to the motor rotor **211** may be controlled to be concentrated on one side with respect to the symmetry.

When the motor rotor **211** and the motor stator **215** are configured to include a permanent magnet and an electromagnet, respectively, it is possible to implement a brushless DC (BLDC) motor or permanent magnet synchronous motor (PMSM) structure.

Alternatively, when the motor rotor **211** and the motor stator **214** are configured to include a magnetic material such as metal and an electromagnet, respectively, it is possible to implement an induction motor or switched reluctance motor (SRM) structure.

The operation and principle in which the magnetic fields are formed through the motor stators **215** so as to rotate the motor rotor **211** and specific components for implementing the operation and principle are based on the well-known technology of the motor field. Therefore, the detailed descriptions thereof are omitted herein.

The motor cover **220** covers the motor rotor **21** and the motor stators **215**, and provides a space to house the motor rotor **211** and the plurality of motor stators **215**.

Referring to FIGS. **2**, **4**, and **5**, the motor cover **220** in accordance with the embodiment of the present invention includes a motor housing portion **221** and a lid portion **225**.

The motor housing portion **221** has a concave shape to house the motor rotor **211** and the motor stators **215** therein. The motor housing portion **221** has a hole **223** through which the shaft portion **213** of the rotor shaft **212** of the motor rotor **211** housed in the motor housing portion **221** passes.

The lid portion **225** covers an opening **222** (refer to FIG. **4**) of the motor housing portion **221**, and is coupled to the motor housing portion **221**.

In the hole **223** formed in the motor housing portion **221** and a concave groove of the lid portion **225**, formed at a position corresponding to the rotation center of the rotor shaft **212**, a plurality of bearings **230** are installed to rotatably support the rotor shaft **212**.

The motor rotor **211** may maintain a state in which the motor rotor **211** is stably installed inside the motor cover **220** with a gap from the inner surface of the motor cover **220** through the bearings **230**, without interference.

The motor cover **220** covers the outer surfaces of the motor stators **215** arranged on the circumference of the motor rotor **211** and a part of the outer surface of the motor rotor **211**, which is not covered by the motor stators **215**.

In the following descriptions, a portion of the motor cover **220** which covers the outer surface of the motor rotor **211** is referred to as a rotor cover portion **220-1**, and a portion of the motor cover **220** which covers the outer surface of the motor stator **215** is referred to as a stator cover portion **220-2**.

Referring to FIG. **5**, the rotor cover portion **220-1** and the stator cover portion **220-2** in accordance with the embodiment of the present invention are integrated with each other while successively extended along the outer surfaces of the motor rotor **211** and the motor stators **215**.

The inner surface of the rotor cover portion **220-1** has a predetermined gap from the outer surface of the motor rotor **211**. Furthermore, the inner surface of the stator cover portion **220-2** has a predetermined gap from the outer surface of the motor stator **215**, like the rotor cover portion **220-1**.

Here, the predetermined gap not only may indicate one numerical vale (for example, 2 mm), but also may indicate a gap range (for example, 2 mm to 2 cm).

Referring to FIG. **5**, the rotor cover portion **220-1** and the stator cover portion **220-2** may have different gaps from the outer surfaces of the motor rotor **211** and the motor stator **215**, respectively.

In this embodiment of the present invention, the rotor cover portion **220-1** and the stator cover portion **220-2** have the predetermined gaps from the outer surfaces of the motor rotor **211** and the motor stator **215**, respectively. However, the motor cover **220** in accordance with the embodiment of the present invention is not limited thereto.

The motor cover **220** in accordance with the embodiment of the present invention may be modified in various manners. For example, only one of the rotor cover portion **220-1** and the stator cover portion **220-2** may have a predetermined gap from the outer surface of the motor rotor **211** or the motor stator **215**.

The caliper connection **240** is formed on the rotor cover portion **220-1** of the motor cover **220** between the motor stators **215** which are arranged on the circumference of the motor rotor **211** so as to be separated from each other.

Referring to FIG. **2**, the caliper connection **240** in accordance with the embodiment of the present invention has a coupling hole formed therein, and a coupling member for coupling the caliper **30** passes through the coupling hole.

The suspension system connection **250** is fixed and installed on the rotor cover portion **220-1** of the motor cover **220** in the space formed between the motor stators **215**, like the caliper connection **240**.

Referring to FIG. **6**, the suspension system connection **250** in accordance with the embodiment of the present invention has a ball joint structure which is easily coupled to an end of the suspension system **40** which performs a rotating operation.

The steering system connection **260** is fixed and installed on the rotor cover portion **220-1** of the motor cover **220** in the space formed between the motor stators **215**, like the suspension system connection **250**.

Referring to FIG. **6**, the suspension system connection **260** in accordance with the embodiment of the present invention has a ball joint structure which is easily coupled to an end of the steering system **60** which performs a rotating operation.

Referring to FIG. **1**, the brake system including the caliper **30**, the end of the suspension system **40**, and the end of the steering system **60** are assembled and coupled to the caliper connection **240**, the suspension system connection **250**, and the steering system connection **260**, respectively.

When the plurality of motor stators **215** are arranged on the circumference of the motor rotor **211** so as to be separated from each other, a space corresponding to the space between the motor stators **215** is formed between the rotor cover portion **220-1** and the wheel **10**.

In the embodiment of the present invention, the caliper connection **240** is formed on the rotor cover portion **220-1** in one of the plurality of spaces formed between the motor stators **215**.

The caliper **30** is connected to the caliper connection **240** in the space formed between the rotor cover portion **220-1** and the wheel **10**.

The suspension system connection **250** and the steering system connection **260** are formed on the rotor cover portion **220-1** in another of the plurality of spaces formed between the motor stators **215**.

The ends of the suspension system **40** and the steering system **60** are connected to the suspension system connection **250** and the steering system connection **260**, respectively, in different spaces formed between the rotor cover portion **220-1** and the wheel **10**.

FIG. **1** illustrates an example in which a MacPherson strut suspension **41** serving as the suspension system **40** is applied to a front wheel.

The MacPherson strut suspension **41** is typically applied to a front wheel. In the case of the front wheel, the steering system **60** may be additionally coupled to the wheel **10**, in addition to the brake system and the suspension system **40**.

As a lower arm **42** of the MacPherson strut suspension **41** is connected to the suspension system connection **250** and the steering system **60** is connected to the steering system connection **260** positioned in the same space as the suspension system connection **250**, it is possible to implement a MacPherson strut suspension structure.

Among components forming the MacPherson strut suspension **41**, a component such as a strut **43**, which is not rotationally driven but fixed and installed on the wheel **10**, may be fixed and installed at a proper position of the motor cover **220**.

The decelerator **270** reduces and outputs the rotational displacement of the motor rotor **211**.

Referring to FIGS. **4**, **5**, and **7**, the decelerator **270** in accordance with the embodiment of the present invention includes a sun gear **271**, a ring gear **272**, a plurality of planet gears **273**, and a carrier **274**.

The sun gear **271** is connected to the shaft portion **213** of the rotor shaft **212** so as to be rotated on the same axis as the motor rotor **211**, and has gear teeth formed on the outer circumference thereof. The ring gear **273** has gear teeth formed on the inner circumference thereof and is installed outside the sun gear **271** so as to be separated from the sun gear **271**. The planet gears **273** are installed between the sun gear **271** and the ring gear **272**, and rotate and revolve in connection with the rotation of the sun gear **271**. The carrier **274** is connected to the rotation centers of the planet gears **273**, and decelerates and rotates at a speed corresponding to the rotation of the planet gears **273**. The carrier **274** has an output shaft **286** formed in the rotation center thereof.

The decelerator **270** performs the deceleration control through a planetary gear train structure in which the sun gear **271**, the ring gear **272**, and the planetary **273** are arranged while forming a concentric circle.

When the ring gear **272** is fixed and the sun gear **271** is rotationally driven, the carrier **274** connected to the plurality of planetary gears **273** is decelerated and rotated in the same direction as the sun gear **271**.

Referring to FIGS. **4**, **7**, and **8**, the hub bearing **280** rotatably supports the output shaft **276** of the decelerator **270**, and is fixed and installed on the motor cover **220**.

The motor cover **220** is fixed and installed on the wheel **10**, and the hub bearing **280** is fixed and installed on the motor cover **220**. The hub bearing **280** is coupled to a brake disk **50**, and the caliper **30** is installed on the caliper connection **240** so as to have a displacement toward the brake disk **50**.

Accordingly, when the brake system is operated, the caliper **30** brakes the wheel **10** while pushing a brake pad toward the brake disk **50**.

The sun gear **271** positioned at one side of the decelerator **270** is rotatably supported by the bearings **230** to support the rotor shaft **212**, and the carrier **274** positioned at the other side of the decelerator **270** is rotatably supported by the hub bearing **280**.

The decelerator **270** may be rotated in place while maintaining a state in which the decelerator **270** is stably supported by the plurality of bearing members including the bearings **230** and the hub bearing **280**.

FIGS. **9** and **10** illustrate an example in which a multi-link suspension **44** serving as the suspension system **40** is applied to a rear wheel. In this case, the steering system connection **260** for coupling the steering system **60** is not formed, unlike the case in which the MacPherson strut suspension **41** is applied

As the lower arm **45** of the multi-link suspension **44** is connected to the suspension system connection **250** in a space where the caliper **30** is not installed among the plurality of spaces formed between the rotor cover portion **220-1** and the wheel **10**, it is possible to implement a multi-link suspension structure.

Among the components forming the multi-link suspension **44**, components such as an upper arm **46** and an assist arm **47** may be fixed and installed at proper positions of the motor cover **220**.

FIG. **11** is a diagram illustrating an example in which a coupled torsion beam axle (CTBA) suspension **48** serving as the suspension system **40** is applied to the rear wheel.

As a spindle mounting bracket **49** is fixed and installed on one surface of the motor cover **220** without interfering with the caliper **30**, it is possible to simply implement the CTBA suspension **48**.

In the in-wheel driving device **200** having the above-described structure in accordance with the embodiment of the present invention, the plurality of motor stators **215** are arranged on the circumference of the motor rotor **211** so as to be separated from each other. Therefore, the plurality of spaces in which other components of the vehicle are installed may be formed between the motor rotor **211** and the wheel **10**.

Furthermore, vehicle components connected to the wheel **10** of the vehicle, such as the brake system, the suspension system **40**, and the steering system **60**, may be freely arranged in the plurality of spaces formed between the motor rotor **211** and the wheel **10**.

That is, the size of the in-wheel motor **210** including the motor rotor **211** and the motor stators **215** does not need to be reduced or the size of the wheel **10** does not need to be increased, but the motor rotor **211**, the motor stators **215**, the brake system, the suspension system **40**, and the steering system **60** may be efficiently mounted in the limited internal space of the wheel **10**.

Furthermore, the plurality of spaces formed between the motor rotor **211** and the wheel **10** may be used to apply various specifications such as the MacPherson strut suspension applied to the front wheel, the multi-link suspension applied to the rear wheel, and the CTBA suspension.

Furthermore, the in-wheel motor **210** having a size corresponding to the wheel **10** may be applied to implement a significant increase in torque, compared to a case in which the size of the in-wheel motor is reduced to a size corresponding to the motor rotor **211**.

The embodiments of the present invention have been disclosed above for illustrative purposes. Those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

What is claimed is:

1. A vehicle wheel with an in-wheel motor, comprising:
   a vehicle wheel comprising a hole with an inner circumference;
   a motor installed inside the hole of the vehicle wheel, the motor comprising a stator and a rotor;
   the rotor comprising a ring shape and rotatable about an axis;
   the stator comprising a first arcuate stator block and a second arcuate stator block; and
   a motor housing comprising a first rotor segment, a first stator segment, a second rotor segment and a second stator segment arranged in order along an angular direction about the axis such that the first and second stator segments are opposingly arranged about the axis,
   wherein the first stator segment houses the first arcuate stator block and the second stator segment houses the second stator block such that the first and second arcuate stator blocks are opposingly arranged about the axis,
   wherein the first and second rotor segments radially smaller than the first and second stator segments such that the motor housing provides:
      a first space that is that radially beyond the first rotor segment and angularly between the first and second stator segment, and
      a second space that is radially beyond the second rotor segment and angularly between the first and second stator segments.

2. The in-wheel motor of claim 1, wherein the first and second stator segments extend about the same angular distance about the axis, wherein the first and second arcuate blocks are diagonally symmetrically arranged about the axis.

3. The in-wheel motor of claim 1, wherein the first and second spaces extend about the same angular distance about the axis.

4. The in-wheel motor of claim 1, wherein the rotor comprises a permanent magnet, and the stator comprises an electromagnet.

5. The in-wheel motor of claim 1, wherein the rotor comprises a magnetic material, and the stator comprises an electromagnet.

6. An in-wheel driving device comprising:
   a motor installed inside a wheel of a vehicle, the motor comprising a rotor and a stator;
   the rotor rotatable about an axis;
   the stator comprising a first arcuate stator block and a second arcuate stator block
   a motor housing comprising a first rotor segment, a first stator segment, a second rotor segment and a second stator segment arranged in order along an angular direction about the axis such that the first and second stator segments are opposingly arranged about the axis,
   wherein the first stator segment houses the first arcuate stator block and the second stator segment houses the second arcuate stator block such that the first and second arcuate stator blocks arr opposingly arranged about the axis,
   wherein the first and second rotor segments radially smaller than the first and second stator segments such that the motor housing provides:
      a first space that is radially beyond the first rotor segment and angularly between the first and second stator segment, and
      a second space that is radially beyond the second rotor segment and angularly between the first and second stator segments;
   a caliper connection configured to connect to a caliper and fixed to one of the first and second rotor segments.

7. The in-wheel driving device of claim 6, wherein the rotor comprises:
   a rotor shaft; and
   a rotating body comprising, a permanent, magnet or magnetic material, coupled to the rotor shaft.

8. The in-wheel driving device of claim 7, wherein first and second stator segments extend about the same angular distance about the axis.

9. The in-wheel driving device of claim 7, wherein the first and second spaces extend about the same angular distance about the axis.

10. The in-wheel driving device of claim 6, wherein the first and second arcuate blocks are diagonally symmetrically arranged about the axis.

11. The in-wheel driving device of claim 10, wherein the first rotor segment faces a portion of the rotor with a predetermined gap therebetween.

12. The in-wheel driving device of claim 10, wherein an inner surface of the first stator segment has a predetermined gap from the first arcuate stator block.

13. The in-wheel driving device of claim 7, further comprising a motor housing lid configured to be placed over the motor housing, wherein the motor housing lid comprises a first rotor edge, a first stator edge, a second rotor edge, a second stator edge that are arranged in order along an angular direction about the axis when placed over the motor housing.

14. The in-wheel driving device of claim 6, further comprising a suspension system connection configured to connect to a suspension system and fixed to one of the first and second rotor segments.

15. The in-wheel driving device of claim 14, wherein the caliper connection is fixed to the first rotor segment, and the suspension system connection is fixed to the second rotor segment.

16. The in-wheel driving device of claim 14, wherein the suspension system connection is configured to connect to a lower arm of a MacPherson strut suspension, and a strut of the MacPherson strut suspension is fixed to the motor housing.

17. The in-wheel driving device of claim 14, wherein the suspension system connection is configured to connect to a lower arm of a multi-link suspension, and an upper arm and an assist arm of the multi-link suspension are fixed to the motor housing.

18. The in-wheel driving device of claim 14, wherein a spindle mounting bracket of a coupled torsion beam axle (CTBA) suspension is fixed to the motor housing.

19. The in-wheel driving device of claim 6, further comprising a steering system connection fixed to one of the first and second rotor segments and configured to connect to a steering system.

20. The in-wheel driving device of claim 19, wherein the caliper connection is fixed to the first rotor segment, and the steering system connection is fixed to the second rotor segment.

21. The in-wheel driving device of claim 6, further comprising:
   a decelerator; and
   a hub hearing rotatably supporting an output shaft of the decelerator and fixed to the motor housing.

22. The in-wheel driving device of claim **21**, wherein the decelerator comprises:

a sun gear connected to the rotor and rotatable about the axis, the sun gear having gear teeth formed on an outer circumference thereof;

a ring gear having gear teeth formed on an inner circumference thereof and installed outside the sun gear;

a plurality of planet gears installed between the sun gear and the ring gear; and

a carrier connected to rotation centers of the planet gears and configured to rotate at a speed corresponding to rotation of the planet gears.

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